

Growing the Space Weather Enterprise

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Roles and Contributions

Space Weather Workshop
Boulder, CO
April 9, 2014

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Agenda

- Policy
 - Space Policies and Laws
- The Space Weather Enterprise
 - Structure
 - Roles
 - Mutual Support
 - Issues
- Opportunities
 - Commercial Space Growth
 - Joint Planning
- Summary

Policy

- Formal
 - National Space Policy (Space Weather?)
 - Agency Policies
 - Congressional Direction
 - Space Act
- Informal
 - Budget Realities
 - Availability of money and accompanying instructions de facto policy
 - Cultural
 - Procedures in Practice
- US Government Weather Data Policies
 - Free to all government agencies
 - Free to all researchers
 - Free to Public
 - Free to weather industry (minimal telecommunications charge)
 - Free to governments worldwide thru World Meteorological Organization (WMO)
 - Government funded satellite systems cannot be sold to private entities
 - Government develops, owns and operates weather satellites (cultural)

U.S. Government Space Policy*

To promote a robust domestic commercial space industry, agencies shall:

- Purchase commercial space services to the maximum extent
- Modify commercial space services when cost effective & timely
- Explore nontraditional arrangements for acquiring commercial space services
- Develop USG space systems only when no US commercial service available
- Refrain from activities that compete with US commercial space activities
- Pursue opportunities for transferring routine space functions to the commercial space sector
- Cultivate entrepreneurship in the commercial space sector through incentives
- Ensure USG space technology available for commercial use

*http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf

U.S. Government Space Policy* (2)

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What about: U.S. Government Laws ???

- Space Business Incentives Act (HR1953)
- Space Transportation Services Purchase Act of 1993 (HR2731)
- The Omnibus Space Commercialization Act of 1996

*http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf

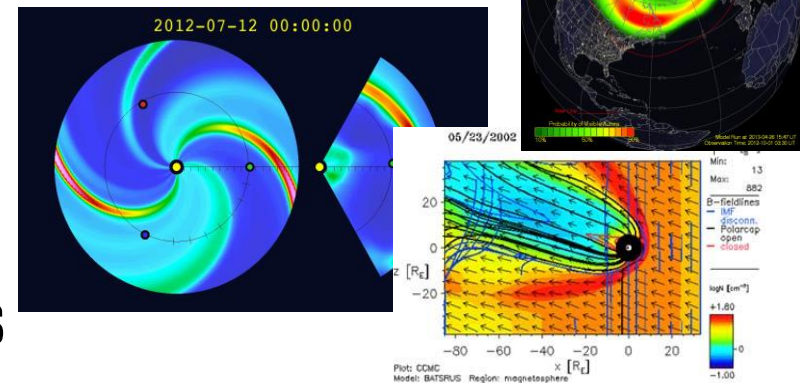
A Weather Ready Nation*

Building our Nation's resilience in the face of increasing vulnerability to space weather

Critical observations



Improved Forecast



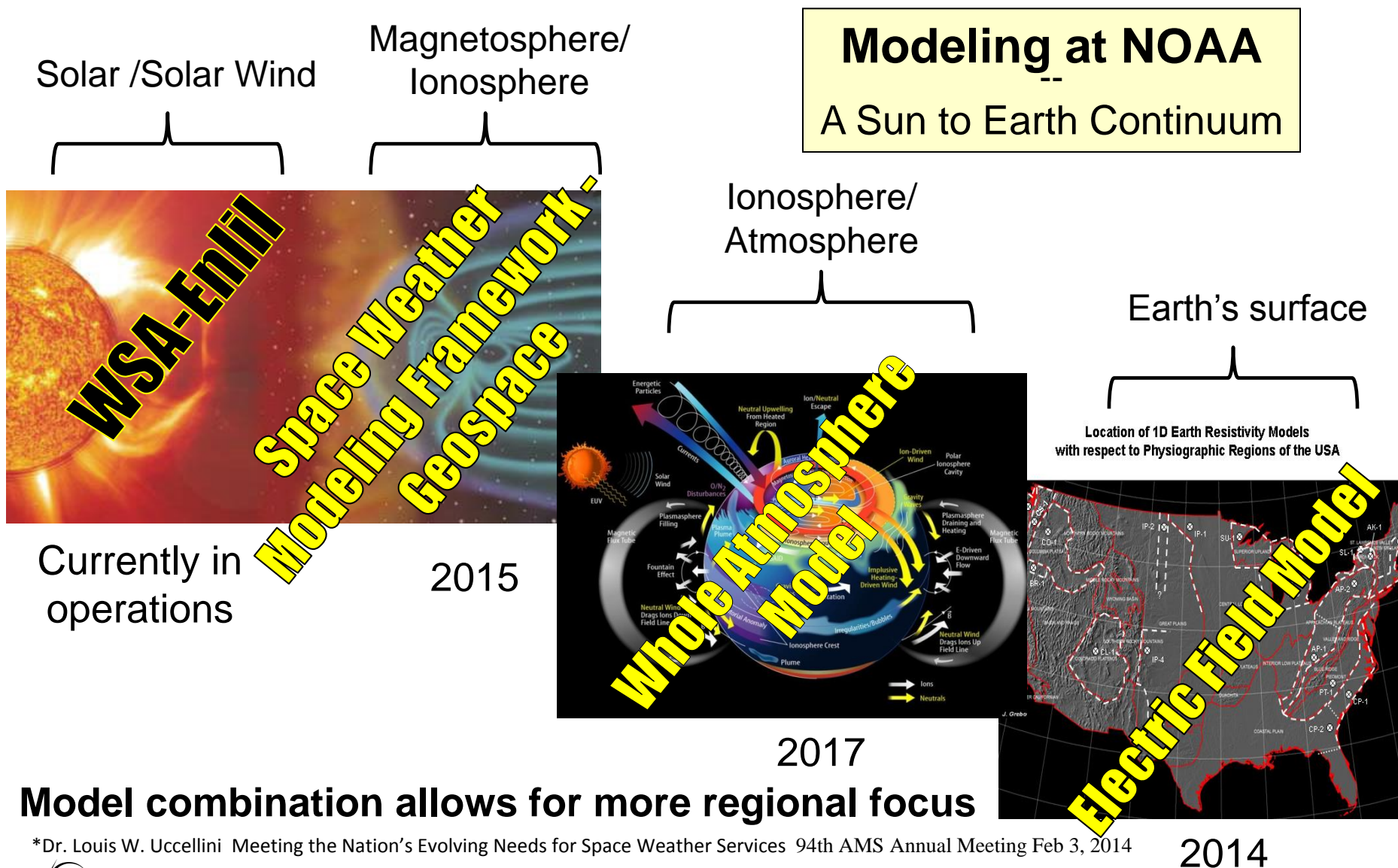
Partnerships



Better information for better decisions

*Dr. Louis W. Uccellini Meeting the Nation's Evolving Needs for Space Weather Services 94th AMS Annual Meeting Feb 3, 2014

Partnerships with Space Weather Research Community*



*Dr. Louis W. Uccellini Meeting the Nation's Evolving Needs for Space Weather Services 94th AMS Annual Meeting Feb 3, 2014

Partnerships

Critical Elements for Meeting National and Global Needs*

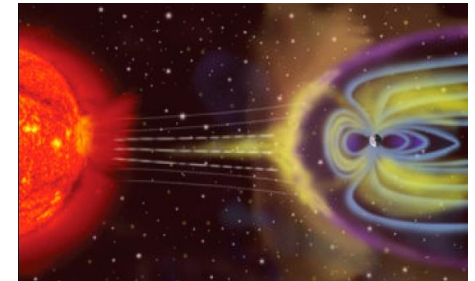


The success of today's space weather industry can NOT be attributed to any one agency, business, corporation, or educational facility. The US Space Weather Enterprise is diverse in its membership – This is a strength that we must recognize.

* Courtesy of William Murtagh

RESPONDING TO THE THREAT*

- Federal Energy Regulatory Commission
 - Standards for Geomagnetic storms
- White House Interagency Working Group
 - Geomagnetically Induced Currents
- Federal Emergency Management Agency
 - Federal Interagency Operations Plan
- North American Electric Reliability Corp.
 - Joint Industry-Government Task Force
- National and International Exercises
 - Secure Grid
 - FEMA/MSB/NOAA
 - National Exercise Program



A Workshop on Managing Critical
Disasters in the Transatlantic Domain—
The Case of a Geomagnetic Storm

February 23-24, 2010



FEMA



* Courtesy of William Murtaugh

American Commercial Space Weather Association

- Formed in 2010;

- Members:

**AER, ASTRA, CPI, CRC, EXPI,
FF, GO, GS, PiQ, PRA, PSI, Q-up,
SAC, SEC, SET, SSI, SSH, SWFTT**

- Executive Committee:

**G. Crowley (ASTRA),
D. Intriligator (CRC),
R. Schunk (SEC),
K. Tobiska (SET)**



www.acswa.us



American Commercial Space Weather Association

Capabilities*

- Algorithm development
- Calibration/validation
- Data assimilation
- GPS modeling and services
- HF propagation
- Numerical modeling and simulation
 - sun, interplanetary medium
 - magnetosphere, ionosphere
 - thermosphere, lower atmosphere
- Operational implementations / Research to Operations (R2O)
- Risk and threat analyses for infrastructure and space resources
- Satellite data analysis & data product development
- Sensor hardware & modeling
- Software tools
 - Application development (web-based and smart phone)
 - Data hosting / data product delivery
 - Data / model visualization
- Space Situational Awareness (SSA)
- Spacecraft anomaly prediction and assessment
- Space weather data product and service distribution
- Space weather now-casting/forecasting

*<http://www.acswa.us/capabilities.html>

The Global Space Economy

Steady Growth!

Sector	\$B	%
Commercial Products & Services	116	6
Commercial Infrastructure & Support	110	11
U.S. Government Space Budgets	48	0
<u>Non U.S. Government Space Budgets</u>	<u>31</u>	<u>1</u>
*Total	\$304B	7

U.S. Government

NASA **\$18B**
 (NOAA \$5B)
 NESDIS **\$2B**
 USAF --**

Stagnant!

*<http://www.spacefoundation.org/programs/research-and-analysis/space-report/20-space-economy>

**Money in budget for weather satellite replacement studies only

Space Weather Enterprise

Products and Services

Upstream

- Research
- Observations
- Instrumentation
- Data

Mid-Stream

- Data Processing
- Computation
- Algorithms
- Models

Downstream

- Forecasts
- Warnings
- Services
- Emergency Mgt

Markets

Com

Acad

Gov't

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Compared to Terrestrial Weather

Fair Weather Report*

- Recognizes the Three Sectors
 - NWS (Government) -- protecting life and property and enhancing the national economy
 - Academia -- advancing science and educating future generations
 - Private Sector – production of products and services tailored to client needs
- System is productive but with built-in frictions
 - All contribute to same activities – Differentiating roles difficult
 - Different philosophies of sharing data and models
 - New technologies and user communities emerge affecting role definition
- Eleven Recommendations
 1. NWS defines processes for making decisions not products
 2. NWS Establish independent advisory body
 3. All three parties seek neutral host to discuss issues periodically
 4. NWS maintain activities essential to mission
 5. NWS Make data and products available in internet accessible formats
 6. NWS Improve process for developing new products that meet new needs
 7. NWS develop process to balance local new product creation with public-private partnership
 8. NWS Adopt/improve processes for communicating information in probabilistic formats
 9. NWS retain role as official source of instrumentation, data, and data collection standards
 10. Private sector work with other sectors to develop processes to minimize friction
 11. Academia use transparent processes to transfer technologies and avoid conflicts of interest

*Fair Weather: Effective Partnerships in Weather and Climate Services (2003) NRC Report

Summary

- National Space Policy and Current Laws
 - Strongly support Commercial Space Development
 - Provide incentive and guidelines for increased Public – Private Partnerships
- NWS future includes important Space Weather Initiatives
 - Supports public – private partnerships.
- Budget pressures continue to limit Government growth
- ACSWA growth aligns with Commercial Space growth
- Government interest in Space Weather increasing
- Fair Weather Report sets example of “how to” partner
- Partnering brings added support for all participants

**It is time for serious and detailed discussion of
ROLES AND CONTRIBUTIONS for the future!**

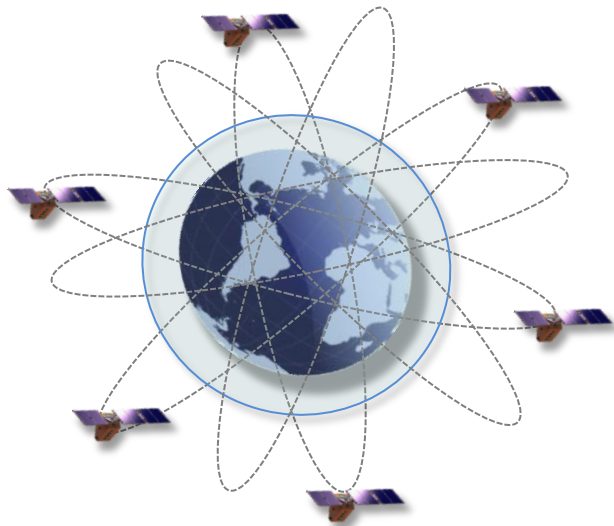


The Environmental Data Services Company

Back-up Slides

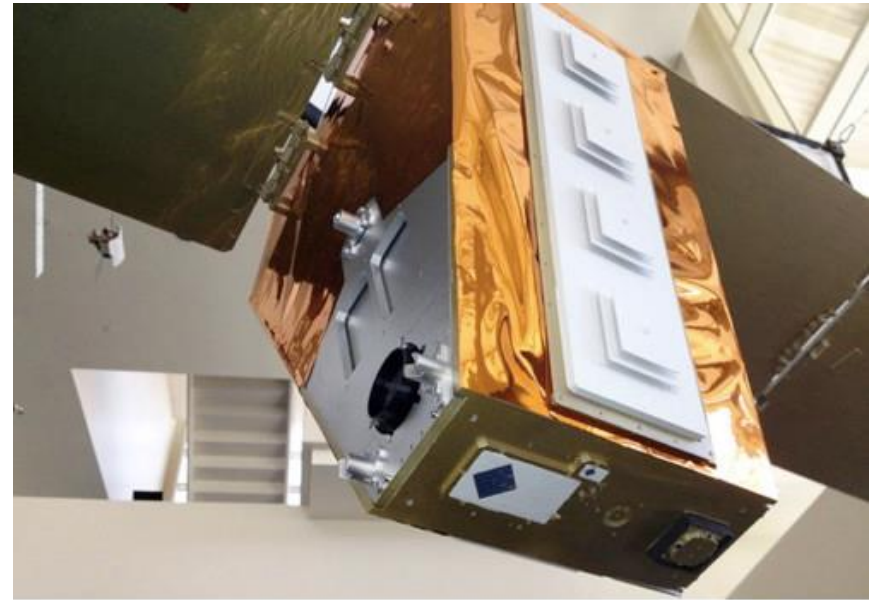
Growing the Space Weather Enterprise

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Public – Private Partnering



The Future!

CICERO



- With many thanks for your attention and interest!
- And a sustainable future for all!

Conrad C Lautenbacher, Jr.

American Commercial Space Weather Association (ACSWA)

Atmospheric and Environmental Research (AER)	Algorithm and Model Development; Systems Trade Studies
Atmospheric & Space Technology Research Associates (ASTRA)	Instrumentation; Software, Firmware, and Hardware; Observation and Information
Carmel Research Center (CRC)	Simulations, Modeling, & Predictions
Computational Physics Inc. (CPI)	First Principles Models; Algorithms, Sensor Modeling, Ground Processing, Cal/Val
Exploration Physics International Inc (expi)	Research, Forecast Services and Products
Flare Forecast	Solar Flare Forecasting, Algorithms and Products
GeoOptics	Satellite Data and Services Provider
PlanetiQ	Satellite Data and Services Provider
Predictive Science, Inc	Modeling and Prediction Services
Q-up Now	Forecasting HF Radio Propagation
Space Environment Corporation (SEC)	Upper Atmosphere Models and Data Analysis Tools
Science Environment Technologies (SET)	Modeling & Simulation of solar irradiances & Indices; Space Weather Data Products
Scientific Solutions, Inc. (SSI)	Imager and Photometer Instrumentation and Data Services
Space Services Holdings, Inc	Public Participation Space Missions; Sunjammer; Nano Launch; Name a Star
Storm Analysis Consultants (SAC)	Analysis of Space Weather Storms and Impacts on Critical Infrastructure
Space Weather For Today and Tomorrow (SWFTT)	Forecasting for Commercial Space Flight Programs

Commercial Satellite Communications

Continent	No. Companies
Asia/Oceania	31
Europe	27
North America	23
South America	5
International	2
Total*	88

GSA Listings**

- Interactive Voice, Video, or Data Networks for applications such as Distance Learning and Telemedicine
- Broadcast Satellite Services with network operations and management support
- Network Diversity/COOP networks such as VSAT backup networks
- Long duration, baseline communications services and infrastructure to support enduring user requirements
- Short duration communications services to support temporary user requirements

Market Size	\$B
Total Space	304
Satellite Communications	149***

• Satellite Communications

- Majority commercial****
 - 54% of all satellites in orbit (1000+ Dec 2012) are communications
 - 70% of those are Commercial
- Bought as a service
- Governments
 - National Defense Agencies
 - Services not satellites
- Cost efficient
- Reliable
- Technically complex

*http://en.wikipedia.org/wiki/List_of_communication_satellite_companies

**<http://www.gsa.gov/portal/> (U.S. government purchasing agency)

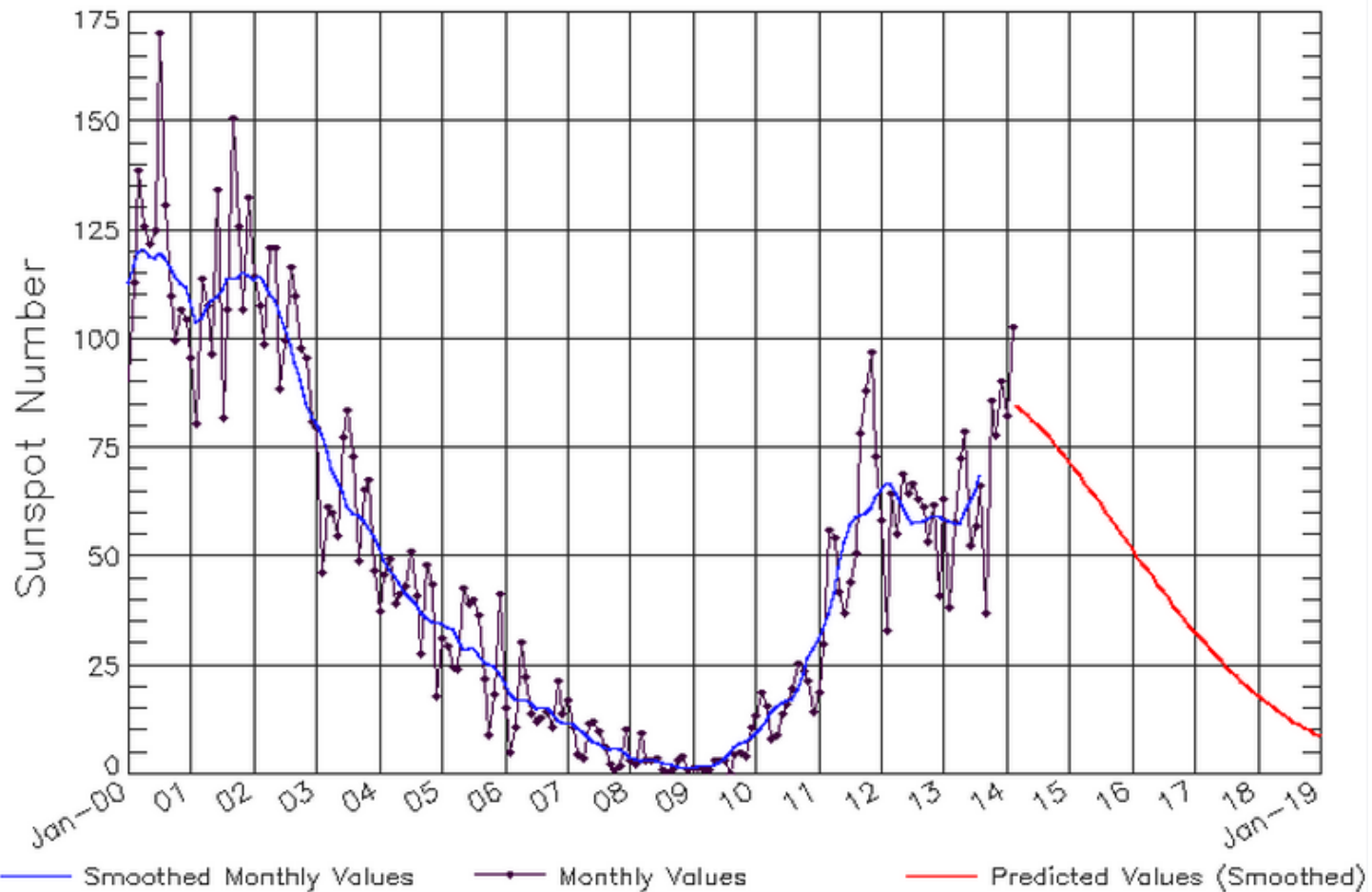
*** SWAG from Space Foundation & Satellite Industry Assoc. data

**** http://www.sia.org/wp-content/uploads/2013/06/2013_SSIR_Final.pdf

Solar Maximum

ISES Solar Cycle Sunspot Number Progression

Observed data through Feb 2014



Updated 2014 Mar 3

NOAA/SWPC Boulder, CO USA

<http://www.swpc.noaa.gov/SolarCycle/>

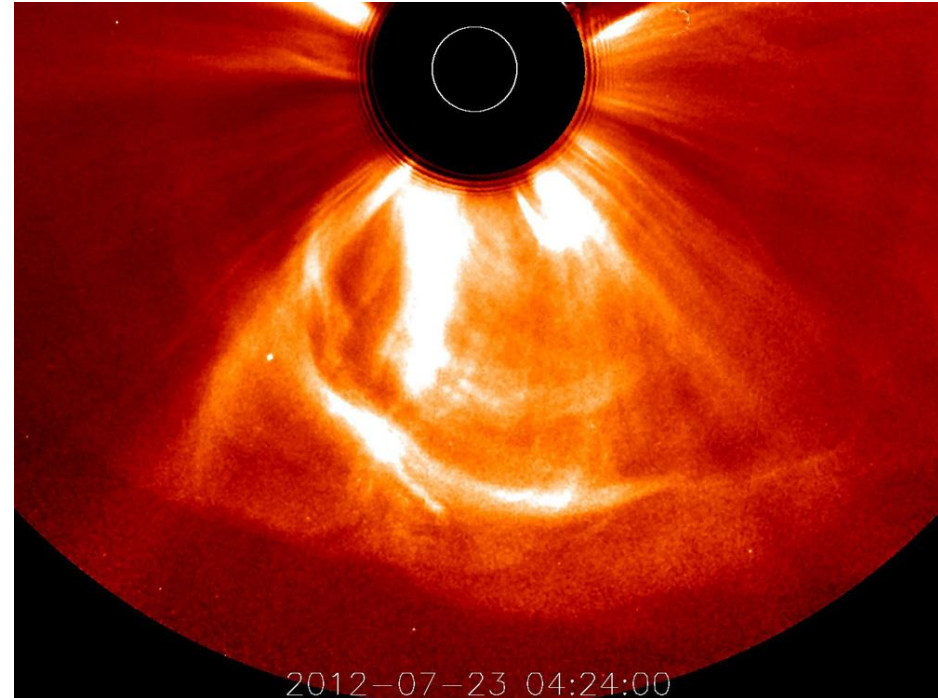
Solar Superstorm

Fierce solar magnetic storm barely missed Earth in 2012*

The solar bursts would have enveloped Earth in magnetic fireworks matching the largest magnetic storm ever reported on Earth, the [Carrington event of 1859](#).

Had the eruption come **nine days earlier**, when the ignition spot on the solar surface was aimed at Earth, it would have **hit the planet**

.... at least two nearly simultaneous coronal mass ejections (CMEs), which typically release energies equivalent to that of **about a billion hydrogen bombs**, separated by only 10 to 15 minutes.



This image captured on July 23, 2012 at 12:24 a.m. EDT shows a coronal mass ejection that left the sun at the unusually fast speeds of over 1,800 miles per second (credit: NASA/STEREO)

*<http://www.kurzweilai.net/fierce-solar-magnetic-storm-barely-missed-earth-in-2012>

Opportunities

Enhanced Public -- Private Sector Partnerships

- Fewer Government Dollars
 - Agencies looking for help to meet requirements and funding
 - Some agency budgets labor intensive (fewer employees)
 - Mutual Support
 - Demand increasing from both government and private sectors
 - NWS already including as part of future budget strategy
 - Potential New Products and Services
 - New Agency Needs could be met by contracted services
 - Data Purchases
 - Commercial Radio Occultation (RO) constellation under development
- Increased public – private dialogue needed
 - Cooperative and Mutually Supporting
 - Division of Public and Private Workload
 - Meeting Needs versus Competition

NWS Organizational Restructure

- Weather Ready Nation (WRN)
 - Invest in research and speed to operations
 - Improved high performance modeling & computing
 - More effective forecast and warning communications
 - A better prepared and responsive public
 - **Enhanced public -- private sector partnerships**
- Budget Restructuring
 - **Less Money (Reductions + Sequestration)**
 - New Categories:
 - Observations**
 - Central Processing**
 - Analyze, Forecast, Assist**
 - Disseminate**
 - Research to Operations**
- Organization to match and support

Visibility Within the Weather and Climate Enterprise

- Presence at 2013 AMS Annual Meeting
 - AMS Short Course
 - Town Hall – Our Stormy Sun
 - 10th Conference on Space Weather
 - 2 & ½ Days of Presentations
- AMS Space Weather Enterprise Session
 - Commercial Sector Issues
 - Competition or Collaboration with Government Sector
 - Government Partnership Policies Helpful
 - Role in Interagency Agreements
 - Overall Efficiency Dictates Using Private Sector Capabilities
 - Open Competition for Government Contracts
 - AMS Commission on the Weather and Climate Enterprise (CWCE)
 - Venue for government, commercial, and academic discussions
 - Strengths
 - Regular Communication Between Sectors
 - Spirit of Collaboration
 - Open Data
 - Open discussions on Division of Duties among Sectors

Increasing Government Awareness

Responding to the Threat*

- Federal Energy Regulatory Commission (FERC)
 - Notice of Proposed Rule Making (NOPR)
 - Reliability Standards for Bulk-Power System
- North American Electric Reliability Corp (NERC)
 - Joint Industry-Government Task Force
 - Redefine Primary Alerting Processes
- White House Geomagnetically Induced Currents Interagency Working Group
 - President directed moving forward with Space Weather mitigation
- National Exercise Program NEP
 - One of 6 scenarios for 2013-2014
- International Activities: Global threat – Global response
 - Now Included in many national risk assessments
 - Beddington-Sullivan Joint Statement -- Space Weather threats

**THE EVOLVING
LANDSCAPE OF
CATASTROPHIC
MANAGEMENT**

Opportunities

Greater Collaboration with the Weather & Climate Enterprise

What is Space Weather Position on _____???

Legislation?

**Weather Service
Reauthorization?**

Weather Commission?

**NWS Budget
Retooling?**

Does
American Weather Industry (AWI)
imply
American Space Weather Industry (ASWI)?

**Go it Alone or Join
with the Weather &
Climate Enterprise?**

Summary

Summary